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(71) Applicant *(for all designated States except US)*: ALFA-LAVAL ZETA A/S [DK/DK]; Krondalsvej 7, DK-2610 Rødovre (DK).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : LINDHOLST, Børge, Arthur [DK/DK]; Højbjerg Vang 40, DK-2840 Holte (DK).

(74) Agent: BUDDE, SCHOU & CO.; H.C. Andersens Boulevard 4, DK-1553 København V (DK).

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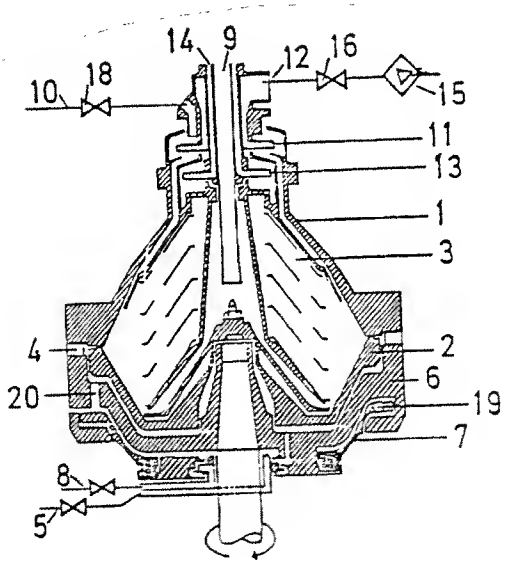

(57) Abstract

In the water outlet pipe (12) of an oil centrifuge, a flow-meter (15) is installed, continuously measuring the amount of outflowing water and, by way of a signal converter, determining the moments for closing and re-opening a valve (16) in the water outlet pipe (12) and for opening and reclosing a valve (18) in the flushing water pipe of the centrifuge before and after each signal for opening the sludge ports (4) of the centrifuge. The oil-water interface in the separation chamber of the centifuge is thereby controlled in such a manner that continuous centrifugalization is maintained during sludge shooting.

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A Method of Controlling the Interface between Oil and Water during Discharge of Sludge from a Centrifuge for Separation of Oil and Water and Sludge.

The invention relates to a method of controlling the interface between oil and water during discharge of sludge from a centrifuge for separation of oil and water or similar fractions and impurities from a mixed liquid carried into the separation chamber of the rotor bowl of a centrifuge, in which oil and water are separated and carried away through their respective outlet pipes, and in which an automatic timer opens the sludge ports from the separation chamber at regular intervals at the same time while flushing water is supplied to the separation chamber in order to maintain the oil-water interface.

It is known to control the oil-water interface during the discharge of sludge from an oil centrifuge by at the same time while supplying mixed liquid to the centrifuge, closing the water outlet and introducing a volume of flushing water corresponding to the volume of sludge to be expelled, along the outer side of the disc stack of the centrifuge and into the separation chamber and forcing the oil-water interface inwardly so that only water and sludge are expelled when the sludge ports are opened at brief injections of operating liquid. After discharge of sludge and water from the separation chamber and closing of the sludge ports, the supply of flushing water is interrupted and the oil-water interface will then adjust to normal centrifuging position.

The activation of the valves in the water outlet pipe and flushing water pipe and of the control liquid valves is performed by means of a timer which is adjusted to operate at greater or smaller intervals dependent on the content of sludge in the supplied oil/water mixture.

This way of controlling is satisfactory when the content of water in the oil is relatively small, e.g. 1 - 2 per cent. However, if the content of water is strong-

ly fluctuating, it is difficult to control the oil-water interface during the discharge of sludge from a centrifuge as the previously mentioned timer functions at fixed time intervals, so that closing of the water outlet while simultaneously supplying flushing water and mixed liquid implies a small content of water which is normally the case in mineral oils for the operation of marine engines in the form of fuel and lubricating oils.

At the occurrence of greater amounts of water in the mixed liquid, the above mentioned control will cause the oil-water interface to be forced so far inwardly towards the centre of the centrifuge bowl that the discharged oil will be mixed up with greater or smaller amounts of water which is unacceptable.

In such cases it will be necessary to interrupt the supply of mixed liquid to the centrifuge in connection with the discharge of sludge, in order to achieve controlled conditions for the oil-water interface, by avoiding the water supply contribution from the mixed liquid.

This, however, results in lost time of production and, if the sludge discharge operations are frequent which is the case of most waste oils and settlings in large bunker fuel tanks in refineries because of the great content of impurities and strongly fluctuating content of water of these oils, the productivity becomes unacceptably small. Consequently, there is a need to be capable of controlling the oil-water interface during the sludge discharge at the same time while supplying mixed liquid, to thereby ensure the largest efficiency of the centrifuge.

According to the invention this is obtained in that the amount of water introduced per time unit is being recorded continuously, preferably by measuring the outflowing water continuously in a flow-meter and that, before giving a signal ordering the control mechanism to open the sludge ports, a signal is given to close the water outlet pipe and to open the flushing water supply

during a time period determined by the water flow during normal centrifugalization and to reopen the water outlet pipe and reclose the flushing water supply at a certain time interval after the signal for sludge shooting, said time interval being determined by the same water flow.

The amount of discharged water measured in the flow-meter is representative of the amount of water supplied with the mixed liquid.

The flow-meter, by way of a signal converter, gives a signal to the control system to open the flushing water pipe and a signal to close the water outlet pipe during a time period determined by the water flow during normal centrifugalization before the signal for discharge of sludge and to reopen the water outlet pipe and close the flushing water pipe at a time interval after the signal for sludge shooting, said time interval being determined by the same water flow.

By continuously recording the amount of discharge water from the centrifuge, it has become possible to obtain immediate control of the oil-water interface while the sludge ports are open in such a way that the oil-water interface in the separation chamber will adjust so that the centrifuge will be working continuously during the discharge of sludge as well and deliver the largest possible amount of clarified oil according to circumstances.

In the following, the invention will be further described with reference to the drawing, in which

Figure 1 shows an axial section through a centrifuge in a separator system controlled by the method according to the invention, and

Figure 2 a simplified diagram of functions for the separator system.

Figure 1 shows an oil centrifuge of known art, comprising a centrifuge rotor having a bowl hood (1) and an axially sliding bowl bottom (2) and a separation chamber with a disc stack (3). Along the circumference

of the separation chamber a plurality of sludge ports (4) are placed, which are opened when the bowl bottom is moved downwards.

During normal centrifugalization, the bowl bottom (2) is kept up by makeup water introduced through a pipe (8) into the compartment between the sliding bowl bottom (2) and the stationary bowl bottom (6) of the rotor via an operating slide (7) which is axially movable in a ring chamber. When the bowl bottom is to be moved downwards for opening the sludge ports (4), operating water is injected through a pipe (5) to the space for the spring-influenced operating slide (7) which moves downwards and opens drain valves (20) between the compartment below the sliding bowl bottom (2) and the ring chamber for the operating slide, from which the water flows out, and the bowl bottom (2) slides fast downwards and opens the sludge ports (4).

When the chamber below the operating slide is filled with water flowing from the drain valves (20) through the channels (19), the pressure difference between the top and under sides of the operating slide is equalized, and the operating slide is again moved upwards by the spring power and builts up again the water pressure in the compartment below the sliding bowl bottom (2) of the rotor.

The above mentioned centrifuge action is called sludge shooting or discharge of sludge.

The supply of the oil-water mixture is performed continuously through a feed line (9) and the flushing water and water for forming a liquid seal, by opening of a valve (18) are carried downwards between the wall of the bowl hood (1) of the rotor and the top disc above the disc stack (3) before starting and during each sludge shooting and adjust the position of the oil-water interface before sludge shooting. During the centrifugalization, the separated water is carried away over a water paring disc (11) through a water outlet pipe (12), whereas clari-

fied oil is carried away over an oil paring disc (13) through an oil discharge pipe (14).

According to the invention, a flow-meter (15) is placed in the water outlet pipe (12), which records the amount of outflowing water and is adapted to provide, by way of a signal converter, a signal to a control circuit which closes a shutoff valve (16) and opens the valve (18) during a time period t_5 determined by the water outflow during normal centrifugalization before the discharge of sludge, and keeps the valve (16) closed and the valve (18) open during another time period t_6 determined by the water outflow during normal centrifugalization, the valves thereafter regaining their normal position.

By the described manner of controlling, it has become possible to obtain an immediate adjustment of the oil-water interface during the discharges of sludge even in case of strongly varying ratios of oil-water mixtures (0 - 100 per cent) in the supplied liquid and, consequently, a continuous operation of the centrifuge under all circumstances and thus, a maximum efficiency.

As an example, the operation of a separator system by the method according to the invention is described in the following with reference to the simplified diagram of functions of Figure 2.

The mixture of oil, water and impurities is supplied to the centrifuge through the feed line (9), and the flow of separated water (e.g. 0 - 7.200 l/h) through the pipe (12) is measured continuously by the flow-meter (15) which provides a signal which is converted by way of a signal converter, e.g. into 4 - 20 mA.

By signal for sludge shooting, either manually by pressing a pushbutton or automatically via timer control or the like, the signal from the signal converter is retained in the control circuit.

The signal is used in the following formula (in which the constants K_1 and k_1 are adapted to the actual centrifuge size):

$$t_5 = \frac{K_1}{k_1 + q}$$ in which

t_5 = time in seconds

q = water outlet in litre/sec.

The time t_5 is used as closing period for the water shutoff valve (16) and opening period for the valve (18) for flushing water before sludge shooting signal.

The signal is also used in the following formula:

$$t_6 = \frac{K_2}{k_2 + q}$$ in which

t_6 = time in seconds

q = water outlet in litre/sec.

The time t_6 is used as closing period for the water shutoff valve (16) and opening period for the valve (18) for flushing water after sludge shooting signal.

In case of a generally occurring size of the centrifuge, for example,

$$t_5 = \frac{4.5}{0.3 + q} \quad \text{and} \quad t_6 = \frac{3.0}{0.3 + q}$$

The above mentioned times adapted to the actual dimensions of the centrifuge have proved to allow a satisfactory purification of oil phase as well of water phase during continuous supply of oil-water mixtures having a strongly fluctuating content of water.

It will be understood that the method according to the invention may be used for separation of other liquid mixtures than oil-water mixtures, and that the control of

the valves (16) and (18) may be performed by means of several other forms of sludge shooting control systems than that described above.

Patent Claims:

1. A method of controlling the interface between oil and water during discharge of sludge from a centrifuge for separation of oil and water or similar fractions and impurities from a mixed liquid carried into the separation chamber of the rotor bowl of a centrifuge, in which oil and water are separated and carried away through their respective outlet pipes, and in which an automatic timer opens the sludge ports from the separation chamber at regular intervals at the same time while flushing water is supplied to the separation chamber in order to maintain the oil-water interface, c h a r a c t e r i z e d in that the amount of water introduced per time unit is being recorded continuously, preferably be measuring the out-flowing water continuously in a flow-meter (15) and that, before giving a signal ordering the control mechanism to open the sludge ports (4), a signal is given to close the water outlet pipe (12) and to open the flushing water supply (10) during a time period determined by the water flow during normal centrifugalization and to reopen the water outlet pipe (12) and reclose the flushing water supply (10) at a certain time interval after the signal for sludge shooting, said time interval being determined by the same water flow.

2. A method according to claim 1, c h a r a c t e r i z e d in that the time period t_5 in seconds, during which the water outlet is closed and the flusing water supply is opened before the sludge shooting, is determined by the following formula:

$$t_5 = \frac{K_1}{k_1 + q}$$

in which the constants are adapted to the size of the centrifuge,

and that the time period t_6 in seconds, during which the water outlet is kept closed, and the flushing water supply is kept open is determined by the formula:

$$t_6 = \frac{K_2}{k_2 + q}$$

in which the constants are adapted to the size of the centrifuge,

in which q = water outflow in litre per second before the closing signal is given.

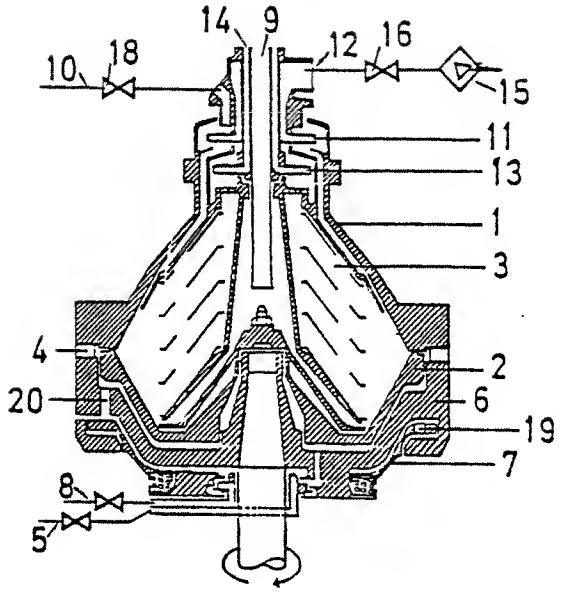
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Fig. 1

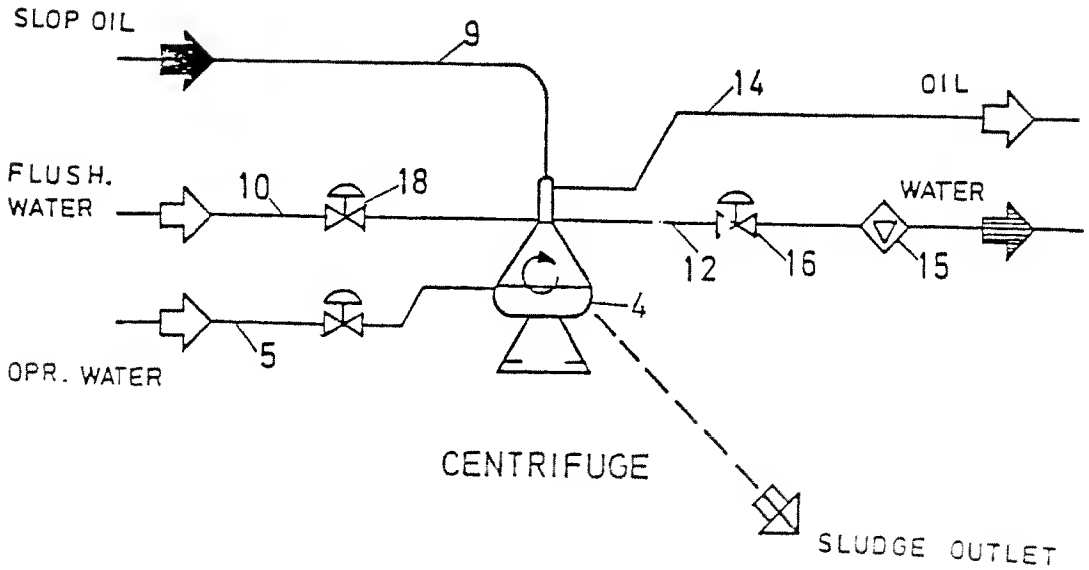
SLOP OIL
9
14
OIL
FLUSH. WATER
10
18
WATER
12
16
15
4
5
OPR. WATER
CENTRIFUGE
SLUDGE OUTLET

Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/DK85/00085

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

B 04 B 11/04

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	B 04 B 11/00, /04, 13/00
Nat Cl	82b:6/10.60, 15
US Cl	233:1, 19, 20, 46, 47; 494:1-85

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	SE, B, 422 416 (BATYREV; ELENBOGEN ET AL) 1979-09-18	
A	DE, A1, 2 814 523 (BATYREV; ELENBOGEN ET AL) 1979-10-18	
A	US, A, 4 475 897 (WESTFALIA SEPARATOR AG) 1984-10-09	

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IV. CERTIFICATION

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